

NASA GSFC OAS MODIS Flood Mapping Products README

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A. PROJECT INFORMATION

MODIS Near Real-Time Global Flood Mapping Project
Office of Applied Science, Code 610.4
NASA Goddard Space Flight Center
Greenbelt MD 20771, USA

PI: Frederick Policelli, frederick.s.policelli at nasa dot gov
Technical Lead/Contact: Dan Slayback, SSAI, dan.slayback at nasa dot gov
Website: <http://oas.gsfc.nasa.gov/floodmap>
Mailing list: <https://lists.nasa.gov/mailman/listinfo/floodmap>

B. PROJECT SUMMARY

The MODIS Near Real-Time Global Flood Mapping Project produces global daily surface and flood water maps at approximately 250 m resolution, in 10x10 degree tiles.

This project was developed in collaboration with Bob Brakenridge at the Dartmouth Flood Observatory (DFO):
<http://floodobservatory.colorado.edu>

This README document provides basic information on distributed products.

C. GEOGRAPHIC INFORMATION

Projection: latitude/longitude geographic

Datum: WGS-84

Pixel size: 0.002197 degrees square (approximately equal to 250 m at the equator)

Grid: products are not on a fixed output grid; the grid of the particular input data for a given date/tile determines the output grid. Our input data are special products from the LANCE MODIS processing system at NASA GSFC (lance-modis.eosdis.nasa.gov). Typically the raster products are 4551 x 4551 pixels in size. However, this may vary by 1-2 pixels depending on the particular input data.

D. FILENAME CONVENTION

PRODUCT_DATE_TILE_COMPOSITE_XTRA.EXT

for example:

MSW_2012009_020E000S_3D30_V.shp
MFW_2012009_020E000S_2D20_V.kmz
MWP_2012009_020E000S_2D20.tif
MFM_2012009_020E000S_2D20.png

PRODUCT:

MFW: MODIS Flood Water
MSW: MODIS Surface Water (eg MFW before subtracting the reference water)
MWP: MODIS Water Product (combines both MFW and MSW)
MFM: MODIS Flood Map = annotated 10x10 degree map/graphic product (currently png format)

See below for additional details on products and distribution formats.

DATE: product date: YYYYDOY

YYYY: 4-digit year.

DOY: 3-digit day of year (001 to 365 or 366).

Note that most products are multi-day composites (see COMPOSITE section below), to get around cloud cover issues. The product date is the LAST day of the composite period. E.g., the date for which the composite is most relevant. Thus, a 3D30 product dated 2012015 would include data from 2012013, 2012014, and 2012015.

TILE: upper left corner of 10-degree product tile: LONGLATI

LONG: Longitude

LATI: Latitude

Example: 000E050N is the tile covering most of France.

COMPOSITE: Product composite: XDYOS (the second to last character is a capital letter O for Observations)

X: number of Days for the product window.

Y: number of Observations required over the window, for a pixel to be labeled water.

S: Shadow masking implemented. This 5th character will be one of:

N: No shadow masking

T: Terrain shadow masking

C: Cloud shadow masking

S: both terrain and cloud Shadow masking

Eg:

2D20T: 2 Days imagery, 2 Observations required, Terrain shadow masking applied

2D10C: 2 Days imagery, 1 Observation required, Cloud shadow masking applied

3D30N: 3 Days imagery, 3 Observations required, No shadow masking applied

1D10S: 1 Day imagery, 1 Observation required, both terrain & cloud shadow masking applied

Currently, the standard product is 2D20T. Alternate products may be available on request.

Requiring multiple observations helps eliminate false detections due to shadows (cloud & terrain).

As of product version 4.4, a draft version of terrain shadow masking is now routinely applied. This eliminates some, but not all, issues of terrain shadow getting tagged as water due to their spectral similarity.

When we have cloud shadow masking tested and ready, we expect to use both cloud and terrain shadow masking in the default product.

XTRA: Extra information, currently only used to denote vector products, but also available for special run variants.

V : Vector product.

V2 : Vector product, filtered with 2 pixel sieve before vectorization (not currently produced).

EXT: Filename extension

.tif, .evf, .png, .shp, .kmz, .zip: appropriate format extension. Shapefiles are zipped for distribution.

E. PRODUCT DISTRIBUTION FORMATS & DETAILS

MFW (MODIS Flood Water), MSW (MODIS Surface Water):

Currently these are only distributed as vector products: shapefiles and KMZ files.

MSW gives all land-based water (with a buffer into oceans) that was observed in the given product.

MFW removes from MSW a reference or expected water layer, such that the remaining water is likely flood.

Polygons in the files represent flood or surface water areas, respectively.

MFW polygons have attributes giving polygon size (in km²), and centroid.

Notes:

There is no indication provided of where there is insufficient clear data in the given product to determine water extent. Thus, these products only indicate where water is likely to be, but the absence of a water polygon cannot be interpreted to mean there was no water present in a given area; it may simply have been sufficiently cloudy over the entire product period for the required number of water observations (the Y in the composite indicator XDY0).

The MWP product (below) attempts to address this deficiency, and may eventually replace MFW and MSW.

MWP (MODIS Water Product):

Introduced March 2012. Currently delivered only in geotiff raster format, with the following pixel values:

0 : Insufficient data to make water determination (cloudy, missing images, swath gaps swaths, or bad data values).
1 : No water detected.
2 : Water detected AND coinciding with reference water (e.g., not flood).
3 : Water detected, beyond reference water, so is likely flood.

To display all surface water (eg., MSW), use all pixels ≥ 2 .

We may also begin distributing a vector product derived from MWP, if there is sufficient user interest.

MFM (MODIS Flood Map):

This is simply the annotated 10x10 degree PNG graphic displayed on the website.

Notes:

Due to the zoomed out scale necessary to display an entire 10x10 degree tile, relatively small areas of flood or surface water will not be visible.

F. ISSUES FOR CONSIDERATION

Cloudiness:

Cloudiness is determined from the "confident cloudy" flag in the 1 km resolution MOD35 cloud product. However, this product often over predicts cloud cover of relevance to our product. Thus, at times, we are able to detect water under areas that MOD35 indicates are "confident cloudy". This is sometimes the case because dark water under thin clouds still appears dark enough to trigger the water detection algorithm. At other times, it occurs because the 1 km MOD35 cloud indicator is simply not sufficiently accurate spatially.

For all products, we keep all water detections, irregardless of MOD35, but do use MOD35 in deriving the "insufficient data" layer, along with areas of no data. Thus, at times, the relevant products may show surface or flood water entirely surrounded by "insufficient data" 0 values.

Although a more accurate 250 m cloud product would be preferable, at this point, MOD35 is the best available.

Shadows:

Shadows appear spectrally quite similar in MODIS bands 1 and 2 to dark water. Thus, our water detection algorithm flags most cloud shadows as water. To avoid this, the standard 2D20 product requires multiple water observations (2, in that case) to flag a pixel as water. This greatly reduces the number of cloud shadows that would otherwise show up as water. Using both Aqua & Terra can also reduce to some degree the terrain shadows, since they provide morning vs afternoon illumination conditions. However in winter in mountainous terrain, there is often substantial number of pixels misidentified as water due to this.

As of version 4.4, we have implemented a terrain shadow masking algorithm that predicts terrain shadows and removes any water pixels that fall under the predicted shadows. Due to limitations in our input data and processing requirements, the current solution is not perfect, and does not remove all terrain shadows, but does reduce their impact, at times substantially. We are working on improvements.

Cloud Shadow masking is still under development, but we expect to implement this later this year (2012).

Both methods may actually remove real water from the products, if either (1) there is water on the surface and it is coincident with predicted terrain or cloud shadow, or (2) the terrain or cloud shadow predictions incorrectly mark areas under shadow.

Note that both methods essentially identify a pixel as indeterminate because we cannot know surface conditions). In the MWP and MFM products, more pixels will thus appear as "insufficient data" if there are not the required number of "clear" images of that pixel available. With "clear" now also requiring no shadows.

Reference Water:

The current MOD44W reference water is not optimal because it is seasonally static and in places out of date (some indicated lakes no longer exist while others have been formed), and thus does not reflect normal seasonal lake and river water height variations.

We will eventually replace this with our own reference water layer developed by analyzing years of data processed with our algorithm.

Sediment load:

Lakes and rivers with a high sediment load, which may appear chalky blue or muddy brown in visible imagery, is usually not detected as water by the current algorithm. This is a fundamentally difficult issue because such water bodies spectrally appear quite similar to certain types of uninundated land surface.

For now, please note that flooding resulting in optically 'bright' water may not be detected in these products.